SIEMENS

SOMATOM AR

CT

DICOM Conformance Statement

Version D10E

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CE

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This device bears a CE mark in accordance with the provisions of the Directive 89/336/EEC* of 3 May 1989 concerning electromagnetic compatibility.

* Modified by Council Directive 91/263/EEC, 92/31/EEC and 93/66/EEC.

The CE mark applies exclusively to medical and technical devices marketed in accordance with the above EEC Directive.

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Introduction

Purpose

DICOM (Digital Imaging and Communications in Medicine) is the industry standard for transferral of radiologic images and other medical information between computers. DICOM enables digital communication between diagnostic and therapeutic equipment and systems from various manufacturers.

This DICOM Conformance Statement describes the details of the implementation of the DICOM standard in the described product. It contains very detailed information about the implementation model (provided services, data flow, functional definitions), the application entity specification (number of connections, transfer syntax, supported formats etc.), and information about vendor specific (private) elements.

The conformance statement is typically used by networking experts to determine how systems of different vendors can be connected.

This DICOM Conformance Statement is written in accordance with to part PS 3.2 of [1].

The applications described in this conformance statement are the SIEMENS SOMATOM products using SOMARIS/3 software.

The SOMARIS DICOM network implementation acts as SCU and SCP for the C-Store DICOM network service.

Scope

This DICOM Conformance Statement refers to SIEMENS CT products using SOMARIS /3 software. The following table relates SOMARIS software names to SIEMENS CT products and software versions. The listed version or a subsequent one is required.

Software Name	SIEMENS CT Product	Software Name
SOMARIS/3	SOMATOM AR	D10E and subsequent

Definitions, Abbreviations

Definitions

DICOM: Digital Imaging and Communications in Medicine
DIMSE: DICOM Message Service Element
DIMSE-C: DICOM Message Service Element with Composite information objects

Abbreviations

ACR: American College of Radiology
AE: DICOM Application Entity
ASCII: American Standard Code for Information Interchange
DS: Decimal String (16 bytes maximum)
IOD: DICOM Information Object Definition
IS: Integer String (12 bytes maximum)
ISO: Internationl Standard Organisation
LO: Long String (12 bytes maximum)
NEMA: National Electrical Manufacturers Association
RIS: Radiology Information System
PDU: DICOM Protocol Data Unit
SCU: DICOM Service Class User (DICOM client)
SCP: DICOM Service Class Provider (DICOM server)
SH: Short String (16 characters maximum)
SOP: DICOM Service-Object Pair
ST: Short Text (1024 chararcters maximum)
UID: Unique IDentifier, string unique in the whole network
UL: Unsigned Long (4 bytes fixed)
US: Unsigned Short (2 bytes fixed)

References

[1]: Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-9, 1993

Connectivity and Interoperability

The implementation of the Siemens DICOM interface has been carefully tested to ensure correspondence with this Conformance Statement. However the Conformance Statement and the DICOM standard do not guarantee interoperability between Siemens modalities and modalities of other vendors. The user must compare the relevant Conformance Statements and if a successful interconnection is to be implemented , the user is responsible to specify an appropriate test suite and for validating the interoperability required. A network environment may need additional functions outside the scope of DICOM.

PART A

DICOM Storage

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CHAPTER
A.1 Implementation Model

The SIEMENS CT DICOM Application Entity results in associations for Storage of DICOM Composite Information Objects in Remote Application Entities.

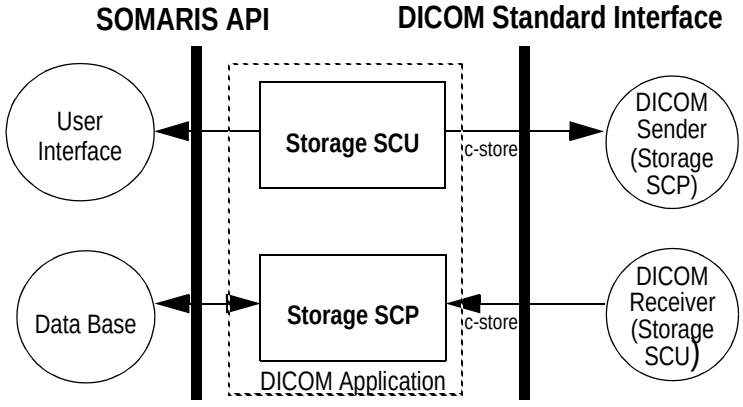
Application Data Flow Diagram

The SOMARIS DICOM network implementation is a UNIX application and acts as SCU and SCP for the C-Store DICOM network service. Storage SCU and Storage SCP handle the DICOM communication.

These applications are started automatically and will be invoked automatically via network.

Upon acceptance of the association by Storage SCP, the remote AE transmits the DICOM Information Objects to Storage SCP. Storage SCP receives each object and converts DICOM 3.0 into the ACR/NEMA format and finally to internal format.

Storage SCU initiates associations for DICOM Storage Service Class to remote AEs. For each folder a new association to the corresponding remote DICOM AE is initiated. The data sets are read in, converted to DICOM 3.0 Information Objects and sent via that open association.



Functional Definitions of Application Entities

All components of the SOMATOM DICOM implementation operate as background daemon processes. They exist as soon as the machine is switched on and awaits tasks.

Storage SCP is acting as a SCP and awaits for association requests from a remote DICOM client. The Application Entity Titles and the Port Number the SCP is monitoring are taken from the local configuration.

Storage SCU acting as a SCU processes orders from the copy processes (i.e. a new copy order arrives via user input and copy server). Upon such a request it initiates an association with a remote Application Entity.

Sequencing of real World Activities

not applicable

DICOM Model of the Real-World

DICOM provides a framework to ensure consistency between various Information Objects, e.g. Study and Series. SOMARIS/3 supports the header objects Study Instance UID and Series Instance UID. These objects are generated by the transfer process and there is no interface to DICOM Real Word e.g. RIS or user.

CHAPTER A.2

Application Entity Specifications

Storage AEs Specification

The CT service class user application provides one AE which is used when initiating associations to remote DICOM nodes.

SIEMENS CT products provide Standard Conformance to the following DICOM V3.0 SOP Classes as a SCU:

SOP Class Name	SOP Class UID
CT Image Information Object Storage	1.2.840.10008.5.1.4.1.1.2

The SIEMENS CT products provides Standard Conformance to the following DICOM V3.0 SOP Classes as a SCP:

SOP Class Name	SOP Class UID
CT Image Information Object Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Information Object Storage	1.2.840.10008.5.1.4.1.1.4
SC (Secondary Capture) Image Information Object Storage	1.2.840.10008.5.1.4.1.1.7
Verification	1.2.840.10008.1.1

Association Establishment Policies

General

The configuration of the SIEMENS DICOM implementation defines the Application Entity Titles, the port numbers and of course the host name and net address.

Number of Associations

The SIEMENS SOMARIS DICOM application initiates one association at a time, one for each transfer request is processed.

Asynchronous Communication

This version of the SIEMENS DICOM toolkit software does not support asynchronous communication (multiple outstanding transactions over a single association).

Implementation Identifying Information

SIEMENS CT DICOM software provides a single Implementation Class UID of

❏ "1.3.12.2.1107.5.1.‘mark for AR + seriesnumber‘"

and an Implementation Version Name of

❏ "SIEMENS_DICOM_10".

Association Initiation Policy

The SIEMENS CT DICOM application attempts to initiate a new association for

❏ DIMSE-C-STORE

service operations.

Associated Real-World Activity

Associated Real-World Activity – Send Image Objects to a remote Node

The associated Real-World activity is a C-Store request initiated by the internal daemon process Storage SCU. If Storage SCU successfully establishes an association to a remote Application Entity, it will convert and then transfer each image of that folder one after another via the open association. If the C-Store Response from the remote Application contains a status other than Success the association is aborted.

The DICOM targets are configured at configuration time.

Proposed Presentation Contexts

The SIEMENS CT DICOM application will propose Presentation Contexts as shown in the following table:

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended
Name	**UID**	**Name List**	**UID List**		**Negotiation**
CT Image Storage Service class	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Big Endian Transfer Syntax,	1.2.840.10008.1.2.2		
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		

SOP Specific Conformance Statement

The DICOM images created by SIEMENS CT DICOM application conform to the DICOM IOD definitions (Standard extended IODs). But they will contain additional private elements which have to be discarded by a DICOM system when modifying the image.

The DICOM nodes are responsible for data consistency when modifying images. All unknown private attributes have to be removed upon modification!

Association Acceptance Policy

The SIEMENS CT DICOM application accepts a new association for

- ❏ DIMSE-C-ECHO
- ❏ DIMSE-C-STORE

service operations.

Associated Real-World Activity

Associated Real-World Activity - Receiving Image Objects from a remote Node

The Storage SCP will accept an association and will receive any images transmitted on that association and store the images on data base.

The DICOM nodes are configured at configuration time.

Proposed Presentation Contexts

The SIEMENS CT DICOM application will propose Presentation Contexts as shown in the following table.

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended
Name	**UID**	**Name List**	**UID List**		**Negotiation**
CT Image Storage Service class	1.2.840.10008.5.1.4.1.1.2	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Big Endian Transfer Syntax,	1.2.840.10008.1.2.2		
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
MR Image Storage Service class	1.2.840.10008.5.1.4.1.1.4	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Big Endian Transfer Syntax,	1.2.840.10008.1.2.2		
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
SC Image Storage Service class	1.2.840.10008.5.1.4.1.1.7	DICOM Implicit VR Little Endian Transfer Syntax,	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Big Endian Transfer Syntax,	1.2.840.10008.1.2.2		
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		

SOP Specific Conformance Statement

The SIEMENS CT DICOM application conforms to the Full Storage Service Class at Level 0. In the event of a successful C-Store operation, the image has successfully been transferred.

The CT DICOM Receiver "Storage SCP" returns the Success status upon successful operation, otherwise one of the following status codes is returned and the association aborted:

- Refused (A700):
  This error status indicates a lack of Resources on the CT modality.
- Error (A900 or C000):
  An error occurred while processing the image which makes it impossible to proceed. The image will not be stored and the association aborted.

Presentation Context Acceptance Criterion

The SIEMENS CT DICOM application will accept any number of verification or storage SOP classes that are listed above. There is no limit on the number of presentation contexts accepted. In the event that the SIEMENS CT DICOM application runs out of resources, it will reject the association request.

Transfer Syntax Selection Policies

The SIEMENS CT DICOM application currently only supports the Implicit VR Little Endian, the Explicit VR Little Endian and Explicit VR Big Endian transfer syntax. Any proposed presentation context which includes one of these transfer syntaxes will be accepted. Any proposed presentation context that does not include one of these transfer syntaxes will be rejected.

General Image Representation

The DICOM images created by SIEMENS CT DICOM conforms to the DICOM IOD definitions. But they will contain additional private elements which have to be discarded by a DICOM system when modifying the image. The DICOM nodes are responsible for data consistency when modifying images. All unknown private attributes have to be removed upon modification.

The details of the image definition is descriped in SOMARIS/4 Data Set Software.

Pixel Representation

The SIEMENS CT DICOM application supports the unsigned 16 bit pixel gray scale and graphic overlay format. The lower 12 bits are used for pixel gray scale and the higher 4 bits are used for the graphic overlay:

- ❏ bits allocated (element 0028, 0100) = 16
- ❏ bits stored (element 0028,0101) = 12
- ❏ high bit (element 0028,0102) = 11
- ❏ pixel representation (element 0028,0103) = 0 - unsigned integer.

CHAPTER A.3

Communication Profiles

Supported Communication Stacks

SIEMENS CT products with software SOMARIS/3 provide DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

OSI Stack

not yet supported

TCP/IP Stack

The SIEMENS CT DICOM application uses the TCP/IP stack from the SUN-OS UNIX system upon which it executes. It uses a subroutine library that is based on a Berkeley socket interface.

API

The SIEMENS CT DICOM application uses a library that is based on a Berkeley socket interface.

Physical Media Support

The SIEMENS CT DICOM application is indifferent to the physical medium through which TCP/IP executes; it inherits this from the SUN-OS UNIX system upon which it executes.

Point-to-Point Stack

not supported

CHAPTER A.4

Extensions/Specializations/ Privatizations

Standard Extended/Specialized/ Private SOPs

The SIEMENS CT DICOM application creates DICOM standard extended Information Objects in such a way that each image can contain additional private elements stored in private groups. These elements are used to store data not defined in DICOM. For more details about these elements see the SIENET Conformance Level Specification.

If these images are modified on DICOM nodes then these applications are responsible for data consistency. All unknown private attributes have to be removed upon modification!

Private Transfer Syntaxes

None

CHAPTER
A.5 Configuration

AE Title / Presentation Address Mapping

The SIEMENS CT DICOM maps Application Entity Titles to host name and port number via an internal configuration method. The IP address for the host name is determined using standard Unix system calls.

For each DICOM unique Application Entity Titles are assigned using the following mechanism:

Each Application Entity Title starts with a unique 10 character string assigned for this DICOM toolkit node. An example for such a string is '049SA1CT39'.

The DICOM Application Entity title of Storage SCP is:
❏ <AEroot>DIC1

The DICOM Sender Application Storage SCU provides the Application Entity Title
❏ <AEroot>0000

The DICOM Receiver Application Storage SCP uses the Port number 50082

Configurable Parameters

The Application Entity Titles, host names and port numbers are configured using the Config Tool of SOMARIS.

This Install Tool also uses some default parameters:

- ❏ max PDU size set to 16384 Bytes (16 kB)
- ❏ time-out for accepting/rejecting an association request: 60s
- ❏ time-out for responding to an association open/close request: 60s
- ❏ time-out for accepting a message over network: 120s

CHAPTER A.6

Support of Extended Character Sets

SOMARIS/3 DICOM application supports the ISO 8859-1 character set.

CHAPTER A.7

SOMARIS/3 DICOM Header VD10E

Attribute Name	Tag	length	special use
Specific Character Set	0008,0005		ISO IR 100
Image Type	0008,0008		Value 3 may be 'UNKNOWN'.
SOP Class UID	0008,0016		
SOP Instance UID	0008,0018		
Study Date	0008,0020		releated to the day when the examination was registered
Acquisition Date	0008,0022		relelated to the day when the examination was performed
Image Date	0008,0023		related to the date when the image calculation was performed
Study Time	0008,0030		
Acquisition Time	0008,0032		related to the time when the acquisition was performed
Image Time	0008,0033		related to the time when the image calculation was performed
Data Set Type	0008,0040		'0' for images
Data Set Subtype	0008,0041		IMA * * = SOMARIS3 Image Type
Accession Number	0008,0050		<null>
Modality	0008,0060		CT
Manufacturer	0008,0070		SIEMENS
Institution Name	0008,0080		
Referring Physician's Name	0008,0090	25	<null>
Station Name	0008,1010		n.a.
Study Description	0008,1030	52	= image comment
Performing Physicians' Name	0008,1050	25	n.a.
Admitting Diagnoses Description	0008,1080	39	n.a.
Manufacturers Model Name	0008,1090	25	

Attribute Name	Tag	length	special use
Patients Name	0010,0010	25	
Patient ID	0010,0020	11	
Patients Birth Date	0010,0030	8	
Patients Sex	0010,0040		
Patients Age	0010,1010		
ContrastBolus Agent	0018,0010		
Body Part Examined	0018,0015		n.a.
Scanning Sequence	0018,0020		n.a.
Slice Thickness	0018,0050		
KVP	0018,0060		
Data Collection Diameter	0018,0090		
Device Serial Number	0018,1000	26	
Software Versions	0018,1020	8	
Distance Source to Detector	0018,1110		
Distance Source to Patient	0018,1111		
GantryDetector Tilt	0018,1120		
Table Height	0018,1130		
Rotation Direction	0018,1140		
Exposure Time	0018,1150		
Exposure	0018,1152		
Generator Power	0018,1170		
Date of Last Calibration	0018,1200		
Time of Last Calibration	0018,1201		
Patient Position	0018,5100		

Attribute Name	Tag	length	special use
Study Instance UID	0020,000D		
Series Instance UID	0020,000E		
Study ID	0020,0010		<null>
Series Number	0020,0011		
Acquisition Number	0020,0012		
Image Number	0020,0013		
Image Position	0020,0030		
Image Position Patient	0020,0032		
Image Orientation	0020,0035		
Image Orientation Patient	0020,0037		
Location	0020,0050		
Frame of Reference UID	0020,0052	47	
Image Geometry Type	0020,0070		
Masking Image	0020,0080		<null>
Position Reference Indicator	0020,1040		<null>
Slice Location	0020,1041		
Source Image ID	0020,3100	0	<null>
Modifying Device ID	0020,3401	0	<null>
Modified Image ID	0020,3402	0	<null>
Modified Image Date	0020,3403	0	<null>
Modifying Device Manufacturer	0020,3404	0	<null>
Modified Image Time	0020,3405	0	<null>
Modified Image Description	0020,3406	0	<null>
Image Comments	0020,4000	52	

Attribute Name	Tag	length	special use
Original Image Identification	0020,5000	0	<null>
Original Image Identification Nomenclature	0020,5002	0	<null>
Samples per Pixel	0028,0002		1
Photometric Interpretation	0028,0004	11	MONOCHROME2
Image Dimensions	0028,0005		
Rows	0028,0010		
Columns	0028,0011		
Pixel Spacing	0028,0030		
Image Format	0028,0040		RECT
Manipulated Image	0028,0050	0	<null>
Bits Allocated	0028,0100	2	16
Bits Stored	0028,0101	2	12
High Bit	0028,0102	2	11
Pixel Representation	0028,0103	2	0
Image Location	0028,0200		
Window Center	0028,1050		
Window Width	0028,1051		
Rescale Intercept	0028,1052		
Rescale Slope	0028,1053		
Pixel Data	7FE0,0010		OB, OW data
Specific Character Set	0008,0005		ISO IR 100

Attribute Name	Tag	length	special use
Image Type	0008,0008		Value 3 may be 'UNKNOWN'.
SOP Class UID	0008,0016		
SOP Instance UID	0008,0018		
Study Date	0008,0020		releated to the day when the examination was registered

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